

## REMARKS ON THE GEOGRAPHICAL DISTRIBUTION OF NORTH AMERICAN COLLEMBOLA.

BY HARLOW B. MILLS, Montana Experiment Station.

In the study of the geographical distribution of insects, the Collembola represent an excellent group for examination. They are primitive in habitat, primitive in organization, and moderately abundant in numbers.

It is doubtful if any other group of animals has so large a percentage of species which are either Holarctic or Cosmopolitan in their distribution. In 1901 Dr. J. W. Folsom (*Psyche*, IX, pp. 159-162) made the first observations on North American Collembola with reference to geographical distribution, and at that time stated: "Twenty-five per cent of the Nearctic species, then, are also Palaearctic. . . . This proportion is increasing with the comparison of additional specimens." At the present time thirty-one per cent of our American species are known to be either Holarctic or Cosmopolitan in their distribution, despite the description of many new indigenous forms.

The relationship of North American forms to those of other continents is primarily with the European fauna. However, a few species are common to North America and Asia. This does not mean that in the final analysis European forms will necessarily bear the same proportionate relationship to Nearctic species as that which pertains now. From the time of Linnaeus the collembolan fauna of Europe has received attention, and is consequently much better known than is that of northeastern Asia, where but few collections have been made.

Excluding obvious synonyms and forms which cannot now be placed, two-hundred-eighty-five species of Collembola are known from North America at the present time. Of these, sixty-eight per cent are indigenous, thirty-one per cent Holarctic or Cosmopolitan, and approximately one per cent common to both this continent and Siberia.

### DISTRIBUTION OF KNOWN NORTH AMERICAN COLLEMBOLOUS SPECIES.

	Podu- ridae	Ento- moby- ridae	Smin- thur- ridae	Total
Indigenous . . . . .	61%	69%	75%	68%
Holarctic or Cosmopolitan . .	35	30	25	31
Asiatic . . . . .	4	1	0	1

While some of the species which are common to two or more faunal regions probably were distributed by commerce, many were without doubt common to these areas before man could have been a factor in distribution. Primitive forms, which are as a rule most widely spread, have many species which have a semi-continuous distribution from North America, through northeastern Canada and Greenland to Northwestern and Central Europe. *Achorutes viaticus*, *A. armatus*, *A. tullbergi*, *A. (Schöttella) uniunguiculata*, *Xenylla humicola*, *Anurida granaria*, *Neanura muscorum*, *Onychiurus armatus*, *O. groenlandicus*, *Tetracanthella wahlgreni*, *Isotoma viridis*, *I. olivacea*, *I. violacea*, *Pseudisotoma sensibilis*, *Archisotoma besselsi*, *Folsomia fimetaria*, *F. quadrioculata*, *F. diplophthalma*, and *Lepidocyrtus cyaneus* all extend from North America through Greenland to Europe, and several of them are circumpolar or Cosmopolitan. Further collection in the north will doubtless increase the list. I have recently examined specimens of *Isotoma bipunctata* and *Deuterosminthurus insignis* collected at Churchill, Manitoba, during the summer of 1936 by H. E. McClure. These species have never before been recorded from North America, but both have long been known in northern Europe.

*Neanura gigantea*, *Onychiurus dentatus*, *Isotoma viridis* and *I. violacea mucronata* have been reported from the Pribilof Islands between Alaska and Siberia.

The greatest percentage of exotic species, according to present records, occurs in the Boreal region of North America as the following table demonstrates:

Location	Indigenous	Holarctic or Cosmopolitan	Asiatic
Boreal (Alaska and North Canada) . . . . .	29%	64%	7%
Temperate (Iowa) . . . . .	56	48	1
Tropical (Costa Rica) . . . . .	75	25	0

In the face of the facts that many species are found in central and northern Europe, the northern Atlantic islands, and the North American continent on the one hand, others in Siberia, the Pribilof Islands, and the North American continent, on the other, and that the proportion of exotic species is greatest in the north where dissemination could most easily take place today (and doubtless much easier during earlier geologic ages), it is logical to believe that much

intercontinental dissemination of species occurred naturally in the north.

At the present time, intercontinental commerce is important in the dissemination of Collembola. Their small size and secretive habits doubtless allow many to enter the United States, despite the fact that literally thousands of individuals and scores of species are intercepted annually at ports of entry. The European *Entomobrya nivalis* appeared almost simultaneously in 1934 on both the Atlantic and the Pacific Coasts. Collembola have been collected on the Atlantic seaboard since the time of Fitch, and surely this species would have appeared in collections previous to 1934 had it been present. Further, it has been intercepted several times at ports of entry. Other European species, such as *Entomobrya corticola*, *Orchesella cincta*, *Sira buski*, and *Sira platani* are apparently restricted to the eastern part of the United States and Canada, and doubtless were introduced from Europe. Indeed, it is surprising that more have not appeared. The "luzerne flea" *Sminthurus viridis*, which is common in Europe and Great Britain, has found its way to Australia where it damages alfalfa, but as yet it has not appeared in more accessible North America.

Collembola are commonly called "snow fleas," but it is interesting to note that they reach their greatest diversity and specialization in the tropics where snow never falls. Primitive forms become less abundant as one travels south, and at the same time the more specialized species increase, as the following table, based on species which can be identified at the present time, will show:

Location	Poduridae (Primitive)	Entomobryi- dae (Inter- mediate)	Sminthuri- dae (Spe- cialized)
Boreal (Alaska and Northern Canada) . . .	42%	44%	14%
Temperate (Iowa) . . . .	36	43	21
Tropical (Costa Rica) . .	30	51	19

The fact that these insects are so definitely dependent on saturated atmospheres for their existence does not seem compatible with their wide distribution. As Folsom (*loc. cit.*) has said, "They lack wings and probably always did, as none are found in the embryo; their feeble walking and leaping could produce only a limited local distribution; a dry spot is an effective barrier to most

Collembola. . . ." There are several ways, however, in which they may be transported, sometimes over great distances. Soil, which is kept moist about the roots of plants will form ideal situations for them. I have taken many species from wet moss used as packing and shipped over one thousand miles, and *Entomobrya assuta* from boxes of peaches.

Water currents doubtless assist in their dispersal. During the spring, when the streams are high, certain species sometimes appear in masses and may be carried considerable distances either directly on the surface or on floating debris. On January 1, 1889, Mr. C. A. Hart examined drifting material in a creek at Urbana, Illinois, and collected the following species: *Achorutes armatus*, *Isotoma viridis*, *Isotomurus palustris*, *Entomobrya assuta*, *E. purpurascens*, *Orchesella ainsliei*, and *Ptenothrix marmoratus*.

Winds may assist in local dissemination of various species. In Dr. Folsom's unpublished notes I find the following record: Near Homer, Illinois, a rain formed a temporary pool on top of a bluff. Shortly afterward, a strong wind started blowing across a stream four-hundred feet away in the valley and over the pool. The aquatic *Sminthurides aquaticus*, and the semi-aquatic *Isotomurus palustris*, which were found along the creek, were soon collected from the surface of the pool. It is doubtful, though, if a Collembolan could stand the desiccation to which it would be subjected on a long stratosphere flight and alight alive.

There are always possibilities of accidental dissemination by animals, but these certainly would be the exceptions. Collembola are often found in rodent burrows, and have been taken from the fur of small animals. They have been found in bird's nests and might be carried in their feathers. While working on a manuscript on Collembola one night a noctuid moth flew in the fourth story window and struck my paper—leaving behind an unharmed specimen of *Deuterostminthurus repandus*.